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Three-dimensional temperature field simulation of complex wax model fabrication in selective laser sintering process based on fully threaded tree

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ABSTRACT

Selective laser sintering (SLS) has been used to fabricate complex wax pattern in investment casting as a process section of fast casting. A high impact polystyrene (HIPS) was developed for wax model of the compressor casing in an international cooperation project. However, the dimensional accuracy can not achieve requirements of investment casting, due to the distorting caused by temperature difference between the sintered parts and the surrounding environment. Numerical simulation and analysis of temperature distribution become significant for suitable process parameters selection. Previous studies have been reported about the temperature distribution during SLS process. However, studies regarding three-dimensional temperature distribution of complex part or wax model are lacking due to the huge calculation and low speed. This study presents a physical model for temperature simulation in the SLS process. A fully threaded tree (FTT) is adopted as the adaptive mesh in the simulations, and detailed refinement and coursing strategies based on the FTT system are explained. Temperature distribution and relevant analysis of the compressor casing wax model is given. The oscillating temperatures in the deposit and the substrate, and temperature bands in the deposit are observed in simulation results. Adopting FTT grid makes it possible to simulate SLS process of complex part such as compressor casing wax model while reducing the computation and improving the computational speed, which help suitable process parameters selection in the real wax model manufacturing.

KEYWORDS: selective laser sintering, SLS, temperature simulations, fully threaded tree, FTT, complex wax model